ASDHS-MLC C2 Series

Half-Slim (JEDEC MO-297)

SATA 6 Gb/s Solid State Drive

Specification

Manual Rev.: 1.00
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Advance Technologies; Automate the World.

Document History

Revision	Date	Changes
1.00	2012/06/04	Initial Release

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1 Introduction

1.1 Overview

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s MLC Solid State Drive (SSD) delivers leading performance a JEDEC MO-297 Half-Slim form factor while simultaneously improving system responsiveness for mobile applications over standard rotating drive media or hard disk drives. By combining leading NAND flash memory technology with our innovative high performance firmware, ADLINK delivers a SSD for native Serial Advanced Technology Attachment (SATA) hard disk drive drop-in replacement with enhanced performance, reliability, ruggedness and power savings, since there are no rotating platters, moving heads, fragile actuators, or unnecessary delays due to spin-up time or positional seek time that can slow down the storage subsystem significantly I/O and throughput performance improvement as compared to rotating media or hard disk drives. This document describes the specifications of the **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s MLC SSD in Half-Slim (JEDEC MO-297) form factor.

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s MLC SSD primarily targets SATA based laptop PCs, highly rugged mobile client devices, as well as thin and light, mini/sub-notebooks. Key attributes include high performance, low power, increased system responsiveness, high reliability, and enhanced ruggedness as compared to standard mobile SATA hard drives. The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s MLC SSD is available in 2.5" and Half-Slim form factors that are electrically, mechanically, and software compatible with existing 2.5” Serial ATA slots and cables. Our flexible design allows interchangeability with existing mobile hard drive based on the SATA interface standard.

1.2 Product Specification

1.2.1. Form Factor: Available in 2.5” and Half-Slim (JEDEC MO-297) SSD form factor

1.2.2. Capacity: 64GB (ASDHS-MLC64G-C2)

Unformatted capacity	Total user addressable sectors in LBA mode
64GB	125,045,424

Table 1: User Addressable Sectors

Notes: 1. 1GB=1,000,000,000 bytes and not all of the memory can be used for storage.

2. 1 Sector = 512 bytes

1.2.3. Flash: Multi-Level Cell (MLC) component with Toggle-Mode (24nm)

1.2.4. Bandwidth Performance (CrystalDiskMark)

Access Type	MB/s
Sequential Read	Up to 350 (SATA 6 Gb/s, Secondary)
Sequential Write	Up to 170 (SATA 6 Gb/s, Secondary)

Table 2: Maximum Sustained Read and Write Bandwidth

Notes: 1). Performance measured using CrystalDiskMark.

2). 1 MB/sec = 1,048,576 bytes/sec is used in measuring sequential performance. If 1 MB/sec = 1,000,000 bytes/sec is used, performance values become 4.85% higher.

1.2.5. Read and Write IOPS (IOMETER)

Access Type	IOPS
4K Read (IOPS)	48,000 (SATA 6 Gb/s, Secondary)
4K Write (IOPS)	38,000 (SATA 6 Gb/s, Secondary)

Table 3: Random Read/Write Input/Output Operations per Second

Notes: 1. Performance measured using IOMETER Pro with queue depth set to 32

2. Write cache enabled

3. Test computer: Dell E6400 (SATA 3 Gb/s - Win7 x64) and Sandy Bridge (SATA 6 Gb/s – Win7 x64)

1.2.6. Power on to ready:

Type	Average Latency
Power on to Ready	1s

Table 4: Latency Specifications

Notes: 1. Write cache enabled

2. Device measured using Drive Master

3. Power on to ready time assumes proper shutdown (Power removal preceded by STANDBY command)

1.2.7. Compatibility

-- SATA Revision 3.0 compliant

Compatible with SATA 1.5Gb/s, 3Gb/s & 6Gb/s interface rates

-- ATA/ATAPI- 8 compliant

-- SSD enhanced SMART ATA feature set

-- Native Command Queuing (NCQ) command set

-- TRIM supported

1.2.8. Certifications

Certification	Description
CE compliant	Indicates conformity with the essential health and safety requirements set out in European Directives Low voltage Directive and EMC Directive
UL certified	Underwriters Laboratories, Inc. Component Recognition UL60950-1
BSMI	Compliance to the Taiwan EMC standard “Limits and methods of Radio Disturbance Characteristics of Information Technology Equipment, CNS 13438 Class B”
Microsoft WHQL	Microsoft Windows Hardware Quality Labs
RoHS compliant	Restriction of Hazardous Substance Directive

Table 6: Device Certifications

1.2.9. Power Management

-- 5V SATA

-- SATA interface power management

-- OS-aware hot plug/removal

1.2.10. Power consumption

Description	Min	Max	Unit
Operating voltage for 5V (+/- 5%)	4.75	5.25	V

Table 7: Operating Voltage

Mode	Type	Unit
Active (average)	2.8	W
Idle (average)	0.7	W

Table 8: Typical Power Consumption

Note: Active power is measured using IOMETER Power Consumption using Data Logger _No DIPM

1.2.11. Temperature

Environment	Mode	Min	Type	Max	Unit
Ambient Temperature	Operating	0		70	°C
	Non-operating	-40		85	°C
Humidity	Operation	5		95	%
	Non-operation	5		95	%

Table 9: Temperature Relative Specifications

Note: Measured without condensation

1.2.12. Reliability

Parameter	Value
Mean Time between Failure (MTBF)	1,500,000 hours
Power on/off cycles	50000 cycles

Table 10: Reliability Specifications

1.2.14. Shock and Vibration:

Item	Mode	Timing/Frequency	Max
Shock[1]	Non-operating	At 1 msec	1500G
	Non-operating	At 2 msec	1000G
Vibration[2]	Operation	7~800 Hz	2.17Grms
	Non-operation	7~800 Hz	3.08Grms

Table11: Shock and Vibration

Notes:

1. Shock specifications assume that the SSD is mounted securely with the input vibration applied to the drive mounting screws. Stimulus may be applied in the X, Y or Z axis
2. Vibration specifications assume that the SSD is mounted securely with the input vibration applied to the drive mounting screws. Stimulus may be applied in the X, Y or Z axis. The measured specification is in root mean squared form.

1.2.15. Electromagnetic Immunity

Electromagnetic Immunity tests assume the SSD is properly installed in the representative host system. The drive operates properly without errors degradation in performance when subjected to radio frequency (RF) environments defined in the following table.

Test	Description	Performance criteria	Reference standard
Electrostatic discharge	Contact ±4KV Air: ±8KV	A	IEC 61000-4-2:2008
Electrostatic discharge	Contact ±6KV Air: ±12KV	B	IEC 61000-4-2:2008
Electrostatic discharge	Contact ±8KV Air: ±15KV	C	IEC 61000-4-2:2008
Radiated RF immunity	80~1000MHz, 3V/m, 80% AM with 1 KHz sine 900 MHz, 3 V/m, 50% pulse modulation at 200Hz	A	IEC 61000-4-3:2008
Electrical fast transient	±1KV on AC mains ±0.5KV on external I/O	B	IEC 61000-4-4:2004 +Corr.1:2006 +Corr.2:2007
Surge immunity	±1KV differential ±2KV common, AC mains	B	IEC 61000-4-5:2008
Conducted RF immunity	150KHz~80 MHz, 3 Vrms, 80% AM with 1KHz sine	A	IEC 61000-4-6:2008
Power frequency magnetic filed	50Hz, 1A/m (r.m.s)	A	IEC 61000-4-6:2008

Table 12: Radio Frequency Specifications

Notes:

1. Performance criterion A = The device shall continue to operate as intended, i.e., normal unit operation with no degradation of performance.
2. Performance criterion B = The device shall continue to operate as intended after completion of test, however, during the test, some degradation of performance is allowed as long as there is no data loss operator intervention to restore device function.
3. Performance criterion C = Temporary loss of function is allowed. Operator intervention is acceptable to restore device function.
4. Contact electrostatic discharge is applied to drive enclosure.

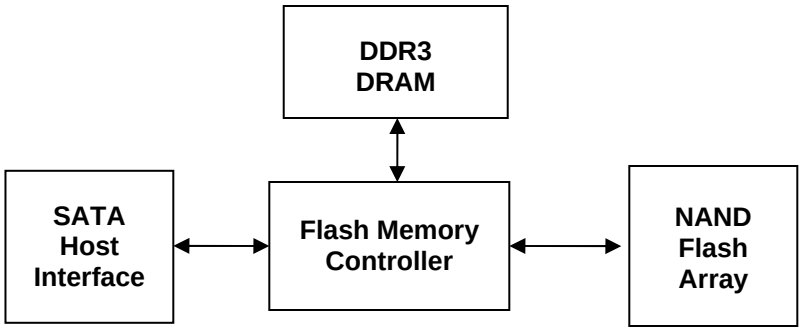
1.2.16. Weight: 10 g Max

1.2.17. Dimension: 39.0 x 54.0 x 4 mm (L x W x H)

1.2.18. Part Numbers:

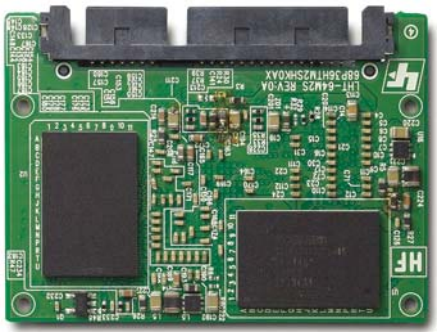
Product Name	Part No.
ASDHS-MLC64G-C2	92-99060-7010

1.3 Functional Block Diagram

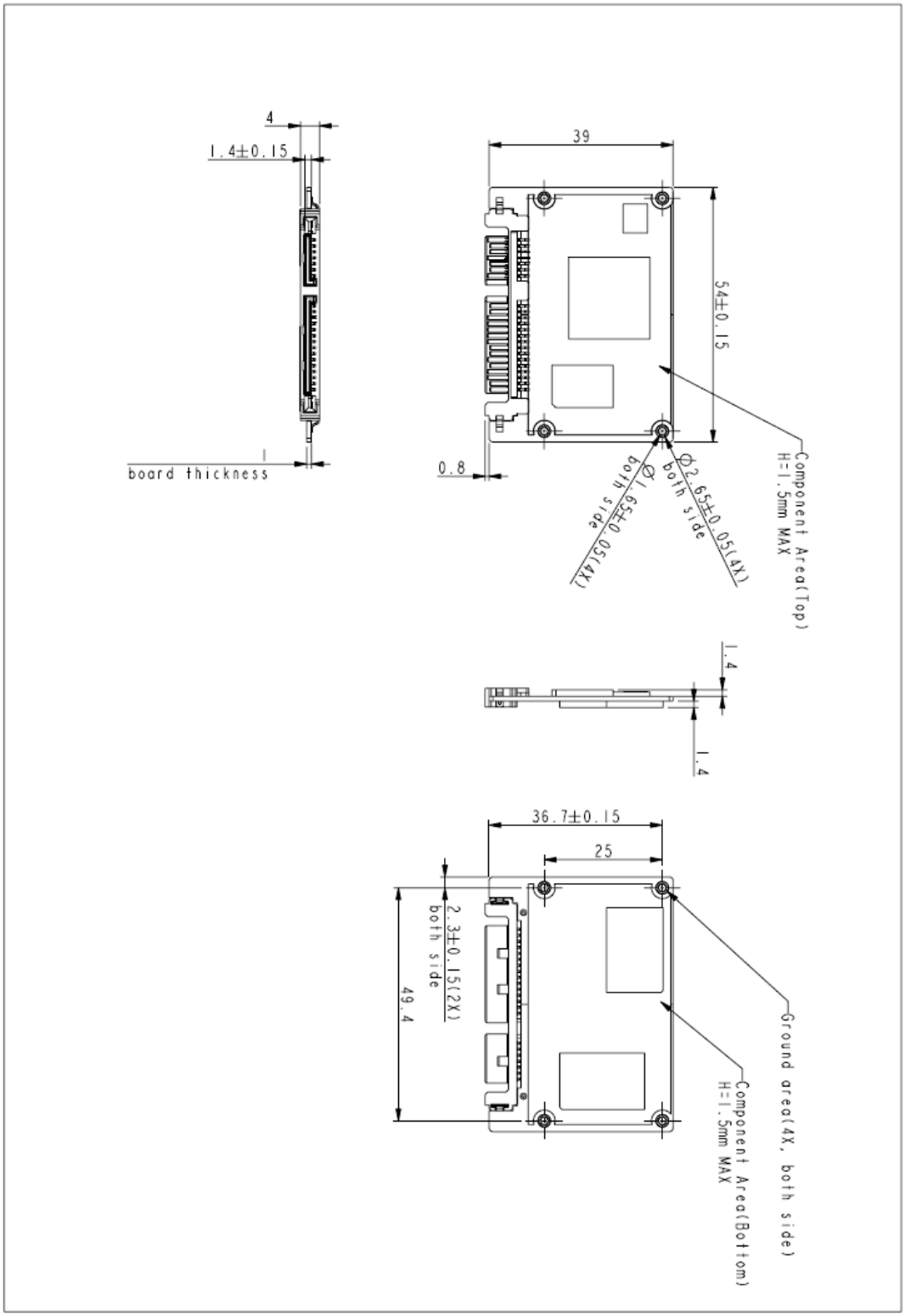


1.4 Product Images

1.4.1. Half-Slim SATA SSD



1.5 Mechanical Drawing: Compatible with JEDEC MO-297 (w/o case)



Dimensions in mm.: 39.0 x 54.0 x 4 mm (L x W x H)

1.6 Architecture

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s Solid State Drive (SSD) utilizes a cost effective system-on-chip (SoC) design to manage a full SATA 6 Gb/s bandwidth with the host while managing multiple flash memory devices on multiple channels internally.

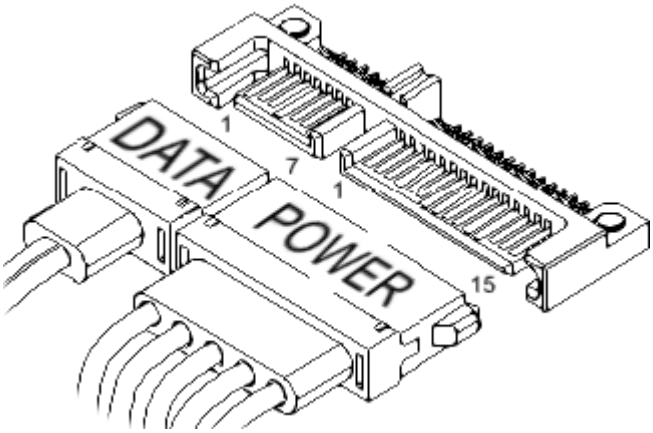
1.7 Hot Plug Support

Hot Plug insertion and removal are supported when the correct connector and an appropriate operating system (OS) are used as described in the SATA 3.0 Specification. This product supports asynchronous signal recovery and will establish communications with a host system without hardware device detection by issuing an unsolicited COMINIT when first mated with a powered connector.

2 Pin Locations and Signal Descriptions

2.1 Pin Locations

The data and power connector pin locations of the **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD are as shown below.



2.2 Signal Descriptions

Data Connector:

Name	Type	Description
S1	GND	
S2	A+	Differential Signal Pair A
S3	A-	
S4	GND	
S5	B-	Differential Signal Pair B
S6	B+	
S7	GND	

Table 13: Serial ATA Data Connector Pin Definitions

Power Connector:

Name	Type	Description
P1	V33	3.3V Power
P2	V33	3.3V Power
P3	V33	3.3V Power, Pre-change
P4	GND	
P5	GND	
P6	GND	
P7	V5	5V Power, Pre-change
P8	V5	5V Power
P9	V5	5V Power
P10	GND	
P11	DAS/DSS	Device Activity Signal / Disable Staggered Spinup
P12	GND	
P13	V12	12V Power, Pre-change
P14	V12	12V Power
P15	V12	12V Power

Table 14: Serial ATA Power Connector Pin Definitions

Note:

1. All pins are in a signal row, with a 1.27mm (0.05”) pitch
2. Pins P1, P2 and P3 are connected together, although they are not connected internally to the device. The host may put 3.3v on these pins.
3. The mating sequence is
    - The ground pins P4-P6, P10, P12 and the 5V power pin P7
    - The signal pins and the rest of the 5V power pins P8-P9
4. Ground connectors P4 and P12 may contact before the other 1st mate pins in both the power and signal connectors to discharge ESD in a suitably configured backplane connector.
5. Power pins P7, P8 and P9 are internally connected to one another within the device.
6. The host may ground P11 if it is not used for Device Activity Signal (DAS)
7. Pins P13, P14, P15 are connected together, although they are not connected internally to the device.

3 ATA Command Sets

3.1 ATA Command

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports all the mandatory ATA commands defined in the ATA/ATAPI-8 specification.

3.1.1. ATA General Feature Command Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the ATA General feature Command set (non-packet), which consists of

- EXECUTE DEVICE DIAGNOSTIC
- FLUSH CACHE
- IDENTIFY DEVICE
- READ DMA
- READ SECTOR(S)
- READ VERIFY SECTORS(S)
- SEEK
- SET FEATURES
- WRITE DMA
- WRITE SECTOR(S)
- READ MULTIPLE
- SET MULTIPLE MODE
- WRITE MULTIPLE

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports all the following optional commands

- READ BUFFER
- WRITE BUFFER
- NOP
- DOWNLOAD MICROCODE

3.1.2. Identify Device Data

The following table details the sector data returned after issuing an IDENTIFY DEVICE command.

Word	F=Fixed V=Variable X=Both	Default Value	Description
0	F	0040h	General configuration bit-significant information
1	X	3FFFh	Obsolete-Number of logical cylinders (16,383)
2	V	C837h	Specific configuration
3	X	0010h	Obsolete-Number of logical heads (16)
4-5	X	0h	Retired
6	X	003Fh	Obsolete-Number of logical sectors per logical track (63)
7-8	V	0h	Reserved for assignment by the Compact Flash Association
9	X	0h	Retired
10-19	F	varies	Serial number (20 ASCII characters)
20-21	X	0h	Retired
22	X	0h	Obsolete
23-26	F	varies	Firmware revision (8 ASCII characters)
27-46	F	varies	Model number
47	F	8010h	7:0 – Maximum number of sectors transferred per interrupt on multiple commands
48	F	0h	Reserved
49	F	2F00h	Capabilities
50	F	4000h	Capabilities
51-52	X	0h	Obsolete
53	F	0007h	Words 88 and 70:64 valid
54	X	3FFFh	Obsolete - Number of logical cylinders (16,383)
55	X	0010h	Obsolete - Number of logical heads (16)
56	X	003Fh	Obsolete - Number of logical sectors per logical track (63)
57-58	X	00FBFC10h	Obsolete
59	F	0101h	Number of sectors transferred per interrupt on multiple commands
60-62	F	125,045,424	Total number of user addressable sectors
63		(64GB)	
64	F	0007h	Multi-word DMA modes supported/selected
65	F	0003h	PIO modes supported
66	F	0078h	Minimum multiword DMA transfer cycle time per word
67	F	0078h	Manufacture's recommended multiword DMA transfer cycle time
68	F	0078h	Minimum PIO transfer cycle time without flow control
69-70	F	0078h	Minimum PIO transfer cycle time with IORDY flow control

Word	F=Fixed V=Variable X=Both	Default Value	Description
71-74	F	0h	Reserved (for future command overlap and queuing)
75	F	0h	Reserved for the IDENTIFY packet DEVICE command
76	F	001Eh	Queue depth
77	F	0106h	Serial ATA capabilities
78	F	0h	Reserved for future Serial ATA definition
79	F	0048h	Serial ATA features supported
80	V	0040h	Serial ATA features enabled
81	F	00FCh	Major Version Number
82	F	001Ah	Minor Version Number
83	F	746Bh	Command set supported
84	F	7C01h	Command sets supported
85	F	6123h	Command set /feature supported extension
86	V	7469h	Command set /feature enabled
87	V	BC01h	Command set /feature enabled
88	V	6123h	Command set /feature default
89	V	407Fh	Ultra DMA modes
90	F	0001h	Time required for security erase unit completion
91	F	0001h	Time required for enhanced security erase completion
92	V	0h	Current advanced power management value
93	V	0FFFEh	Master Password Revision Code
94	F	0h	Hardware reset result. The contents of bits (12:0) of this word shall change only during the execution of a hardware reset.
95	V	0h	Vendor's recommended and actual acoustic management value
96	F	0h	Stream Minimum Request Size
97	V	0h	Streaming Transfer Time - DMA
98-99	V	0h	Streaming Access Latency - DMA and PIO
100-103	F	0h	Streaming Performance Granularity
104	V	125,045,424	Maximum user LBA for 48-bit Address feature set
105		(64GB)	
106	V	0h	Streaming Transfer Time - PIO
107	F	0h	Reserved
108-111	F	4000h	Physical sector size/logical sector size
112-115	F	0h	Inter-seek delay for ISO-7779 acoustic testing in microseconds
116	F	varies	Unique ID
117-118	F	0h	Reserved for word wide name extension to 128 bits
119	V	0h	Reserved for technical report
120	F	0h	Words per logical sector

Word	F=Fixed V=Variable X=Both	Default Value	Description
121-126	F	401Ch	Supported settings
127	F	401Ch	Command set/feature enabled/Supported
128	F	0h	Reserved
129-159	F	0h	Removable Media Status Notification feature set support
160	V	0021h	Security status
161-175	X	0h	Vendor specific
176-205	F	0h	Compact Flash Association (CFA) power mode 1
206-216	X	0h	Reserved for assignment by the CFA
217	V	0h	Current media serial number
218-221	F	0h	Reserved
222	F	0001h	Non-rotating media device
223-233	F	0h	Reserved
234	F	101F	Reserved
235	F	0h	Reserved
236-254		0001h	Reserved
255		02A0h	Reserved
236-254	F	0h	Reserved
255	X	varies	Integrity word (checksum and signature)

Table 15: Returned Sector Data

Notes:

1. F=Fixed. The content of the word is fixed and does not change for removable media devices, these values may change when media is Removed or changed.
2. V=Variable. The state of at least one bit in a word is variable and may change depending on the state of the device or the commands executed by the device.
3. X=F or V. The content of the word may be fixed or variable.

3.2 Power Management Command Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the power management command set, which consists of

- CHECK POWER MODE
- IDLE
- IDLE IMMEDIATE
- SLEEP
- STANDBY
- STANDBY IMMEDIATE

3.3 Security Mode Feature Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the Security Mode command set, which consist of

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT
- SECURITY FREEZE LOCK
- SECURITY DISABLE PASSWORD

3.4 SMART Command Set

The **ASDHS-MLC64G** SATA SSD supports the SMART command set, which consist of

- SMART ENABLE OPERATIONS
- SMART DISABLE OPERATIONS
- SMART ENABLE/DISABLE AUTOSAVE
- SMART RETURN STATUS

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the the following optional commands.

- SMART EXECUTE OFF-LINE IMMEDIATE
- SMART READ DATA
- SMART READ LOG
- SMART WRITE LOG

The table below lists the SMART commands.

Subcommand	Code	LBA Low value
SMART ATTRIBUTE VALUES (READ DATA)	D0h	
READ ATTRIBUTE THRESHOLDS	D1h	
ENABLE/DISABLE ATTRIBUTE AUTOSAVE	D2h	
SAVE ATTRIBUTE VALUES	D3h	
EXECUTE OFF-LINE IMMEDIATE	D4h	
EXECUTE SMART OFF-LINE ROUTINE		00h
EXECUTE SMART SHORT SELF-TEST ROUTINE (OFFLINE)		01h
EXECUTE SMART EXTENDED SELF-TEST ROUTINE (OFFLINE)		02h
ABORT OFF-LINE ROUTINE		7Fh
EXECUTE SMART SHORT SELF-TEST ROUTINE (CAPTIVE)		81h
EXECUTE SMART EXTENDED SELF-TEST ROUTINE (CAPTIVE)		82h
READ LOG SECTOR	D5h	
WRITE LOG SECTOR	D6h	
ENABLE SMART OPERATIONS	D8h	
DISABLE SMART OPERATIONS	D9h	
RETURN SMART STATUS	DAh	

Table 16: SMART commands

3.5 Host Protected Area Command Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the Host Protected Area command set which consists of

- READ NATIVE MAX ADDRESS
- SET MAX ADDRESS
- READ NATIVE MAX ADDRESS EXT
- SET MAX ADDRESS EXT

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the following optional commands.

- SET MAX SET PASSWORD
- SET MAX LOCK
- SET MAX FREEZE LOCK
- SET MAX UNLOCK

3.6 48-Bit Address Command Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the Host Protected Area command set, which consists of

- READ NATIVE MAX ADDRESS
- FLUSH CACHE EXT
- READ DMA EXT
- READ NATIVE MAX ADDRESS EXT
- READ SECTOR(S) EXT
- READ VERIFY SECTOR(S) EXT
- SET MAX ADDRESS EXT
- WRITE DMA EXT
- WRITE MULTIPLE EXT
- WRITE SECTOR(S) EXT

3.7 Device Configuration Overlay Command Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the Device configuration Overlay command set, which consists of

- DEVICE CONFIGURATION FREEZE LOCK
- DEVICE CONFIGURATION IDENTITY
- DEVICE CONFIGURATION RESTORE
- DEVICE CONFIGURATION SET

3.8 General Purpose log Command Set

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the general purpose log command set, which consists of

- READ LOG EXT
- WRITE LOG EXT

4 SATA Command Sets

4.1 SATA Command

The SATA 3.0 specification is a super set of the ATA/ATAPI-8 specification with regard to supported commands. The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the following features which are unique to SATA Specification.

4.1.1. Software Settings Preservation

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the SET FEATURES parameter to enable/disable the preservation of software settings.

4.1.2. Native Command Queuing

The **ASDHS-MLC64G** Half-Slim SATA 6 Gb/s SSD supports the Native Command Queuing (NCQ) command set, which includes.

- READ FPDMA QUEUED
- WRITE FPDMA QUEUED

Note: with a maximum queue depth equal to 31

5 References

This document references standards defined by a variety of organizations use the following list to identify the location of an organization's standards information.

Date	Title	Location
Dec 2008	VCCI	http://www.vcci.or.jp/vcci_e/general/join/index.html
July 2007	ROHS	Search for material description datasheet at http://intel.pcnalert.com
July 2007	SFF-8144, 1.8" drive form factor	http://www.sffcommittee.org
February 2007	Serial ATA Revision 2.6	http://www.sata-io.org
May 2006	SFF-8223, 2.5" Drive w/Serial Attachment Connector	http://www.sffcommittee.org
May 2005	SFF-8201, 2.5" drive form factor	http://www.sffcommittee.org
April 2004	ATA-7 Spec. Volume 1	http://www.t13.org/
Aug. 2009	ATA-8 Spec. Rev 2	http://www.t13.org/
1995 1996 1995 1995 1997 1994	International Electro Technical Commission EB61000 4-2 Personnel Electrostatic Discharge Immunity 4-3 Electromagnetic compatibility (EMC) 4-4 Electromagnetic compatibility (EMC) 4-5 Electromagnetic compatibility (EMC) 4-6Electromagnetic compatibility (EMC) 4-11 (Voltage variations)	http://www.iec.ch
1995	ENV 50204 (Radiated electromagnetic field from digital radio telephones)	http://www.iec.ch

Table 17: Standards References

6 Getting Service

Contact us should you require any service or assistance.

ADLINK Technology, Inc.

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Fax: +1-408-360-0222
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